Ecological site F115XB003MO
Deep Loess Protected Backslope Forest

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 115X–Central Mississippi Valley Wooded Slopes

This MLRA is characterized by deeply dissected, loess-covered hills bordering well defined valleys of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers and their tributaries. It is used to produce cash crops and livestock. About one-third of the area is forested, mostly on the steeper slopes. This area is in Illinois (50 percent), Missouri (36 percent), Indiana (13 percent), and Iowa (1 percent) in two separate areas. It makes up about 25,084 square miles (64,967 square kilometers).

Most of this area is in the Till Plains section and the Dissected Till Plains section of the Central Lowland province of the Interior Plains. The Springfield-Salem plateaus section of the Ozarks Plateaus province of the Interior Highlands occurs along the Missouri River and the Mississippi River south of the confluence with the Missouri River. The nearly level to very steep uplands are dissected by both large and small tributaries of the Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers. The Ohio River flows along the southernmost boundary of this area in Indiana. Well defined valleys with broad flood plains and numerous stream terraces are along the major streams and rivers. The flood plains along the smaller streams are narrow. Broad summits are nearly level to undulating. Karst topography is common in some parts along the Missouri and Mississippi Rivers and their tributaries. Well-developed karst areas have hundreds of sinkholes, caves, springs, and losing streams. In the St. Louis area, many of the karst features have been obliterated by urban development.

Elevation ranges from 90 feet (20 meters) on the southernmost flood plains to 1,030 feet (320 meters) on the highest ridges. Local relief is mainly 10 to 50 feet (3 to 15 meters) but can be 50 to 150 feet (15 to 45 meters) in the steep, deeply dissected hills bordering rivers and streams. The bluffs along the major rivers are generally 200 to 350 feet (60 to 105 meters) above the valley floor.

The uplands in this MLRA are covered almost entirely with Peoria Loess. The loess can be more than 7 feet (2 meters) thick on stable summits. On the steeper slopes, it is thin or does not occur. In Illinois, the loess is underlain mostly by Illinoian-age till that commonly contains a paleosol. Pre-Illinoian-age till is in parts of this MLRA in Iowa and Missouri and to a minor extent in the western part of Illinois. Wisconsin-age outwash, alluvial deposits, and sandy eolian material are on some of the stream terraces and on dunes along the major tributaries. The loess and glacial deposits are underlain by several bedrock systems. Pennsylvanian and Mississippian bedrock are the most extensive. To a lesser extent are Silurian, Devonian, Cretaceous, and Ordovician bedrock. Karst areas have formed where limestone is near the surface, mostly in the southern part of the MLRA along the Mississippi River and some of its major tributaries. Bedrock outcrops are common on the bluffs along the Mississippi, Ohio, and Wabash Rivers and their major tributaries and at the base of some steep slopes along minor streams and drainageways.

The annual precipitation ranges from 35 to 49 inches (880 to 1,250 millimeters) with a mean of 41 inches (1,050 millimeters). The annual temperature ranges from 48 to 58 degrees F (8.6 to 14.3 degrees C) with a mean of 54 degrees F (12.3 degrees C). The freeze-free period ranges from 150 to 220 days with a mean of 195 days.

Soils The dominant soil orders are Alfisols and, to a lesser extent, Entisols and Mollisols. The soils in the area have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. They are shallow to very deep, excessively drained to poorly drained, and loamy, silty, or clayey.

The soils on uplands in this area support natural hardwoods. Oak, hickory, and sugar maple are the dominant species. Big bluestem, little bluestem, and scattered oak and eastern redcedar grow on some sites. The soils on flood plains support mixed forest vegetation, mainly American elm, eastern cottonwood, river birch, green ash, silver maple, sweetgum, American sycamore, pin oak, pecan, and willow. Sedge and grass meadows and scattered trees are on some low-lying sites. (United States Department of Agriculture, Natural Resources Conservation Service, 2022)

LRU notes

The Central Mississippi Valley Wooded Slopes, Western Part consists of deeply dissected, loess-covered hills bordering the Missouri and Mississippi Rivers as well as floodplains and terraces of these rivers. The Northern boundary runs along the South Fabius River valley separating it from the broad rounded interfluves of the northern till plain. A major physiographic feature within the LRU (Land Resource Unit) includes the Lincoln Hills region. The Lincoln Hills extend along the Mississippi River in Missouri, starting about 40 miles (64 kilometers) northwest of St. Louis and extending north to Hannibal. The Lincoln Hills partially escaped the most recent glaciation in the region during the Pleistocene. In geology and biology, they resemble the rugged and forested hills of the Ozark Highlands (MLRA 116A) more than the rolling plains of northern Missouri. The underlying limestone bedrock has formed bluffs, glades, caves, springs, and sinkholes. Elevation ranges from about 420 feet (128 meters) along the Mississippi River near Cape Girardeau, Missouri to about 830 feet (253 meters) near Clarksville along the Mississippi River upstream from St. Louis. High ridges near Hillsboro, Missouri can reach over 1,000 feet (305 meters). Underlying bedrock is mainly Ordovician-aged dolomite and sandstone, with Mississippian-aged limestone north of the Missouri River. Loess caps both stream and glacial outwash terraces along the major rivers along with Pre-Illinoisan till near the edges of the area.

Classification relationships

Major Land Resource Area (MLRA) (USDA-NRCS, 2022):
115X–Central Mississippi Valley Wooded Slopes

Terrestrial Natural Community Type in Missouri (Nelson, 2010):
The reference state for this ecological site is most similar to a Mesic Loess/Glacial Till Forest.

Missouri Department of Conservation Forest and Woodland Communities (MDC, 2006):
The reference state for this ecological site is most similar to a Mixed Hardwood Mesic Forest.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to a Quercus alba - Quercus rubra - Acer saccharum - Carya cordiformis / Lindera benzoin Forest (CEGL002058).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site occurs in many Land Type Associations of the following Subsections:
Inner Ozark Border
Outer Ozark Border
Mississippi River Hills

Ecological site concept

Deep Loess Protected Backslope Forests occupy the northerly and easterly aspects of steep, dissected slopes, and are mapped in complex with the Deep Loess Exposed Backslope Woodland ecological site. These sites are adjacent to the Missouri and Mississippi River Floodplains. In some areas they occupy the entire hillslope. In other

areas, Chert or Limestone/Dolomite ecological sites are on lower slopes. Upslope summit areas are typically Deep Loess Upland Woodland ecological sites. Soils are very deep, with no rooting restrictions. The reference plant community is forest dominated by northern red oak, white oak, white ash and sugar maple, with a well-developed understory and a rich herbaceous ground flora.

Associated sites

F115XB001MO	**Deep Loess Upland Woodland** Deep Loess Upland Woodlands are upslope on summit positions from this ecological site
F115XB008MO	**Loamy Limestone/Dolomite Protected Backslope Forest** Loamy Limestone/Dolomite Protected Backslope Forests are on similar aspects but on the lower backslopes underlain with limestone and/or dolomite bedrock at 20 to 40 inches.
F115XB045MO	**Loamy Limestone/Dolomite Exposed Backslope Woodland** Loamy Limestone/Dolomite Exposed Backslope Woodlands are on the lower exposed backslopes underlain with limestone and/or dolomite bedrock at 20 to 40 inches.
R115XB018MO	**Limestone/Dolomite Protected Cliff** Limestone/Dolomite Protected Cliffs are sometimes present below this ecological site on major floodplains.

Similar sites

F115XB043MO	**Deep Loess Exposed Backslope Woodland** Deep Loess Exposed Backslope Woodlands are mapped in a complex with this ecological site on south and west facing slopes

Table 1. Dominant plant species

Tree	(1) *Quercus rubra* (2) *Quercus alba*
Shrub	(1) *Asimina triloba*
Herbaceous	(1) *Laportea canadensis* (2) *Erigenia bulbosa*

Physiographic features

This site is on upland backslopes, with slopes of 15 to 60 percent. It is on protected aspects (north, northwest, northeast, and east), which receive significantly less solar radiation than the exposed aspects. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The accompanying figure (adapted from Young et al., 2003) shows the typical landscape position of this ecological site, and landscape relationships with other ecological sites in the uplands adjacent to the Missouri River. The site is within the area labeled “1”, on steep backslopes with northerly and easterly aspects. Deep Loess Upland sites are directly upslope, and are included within the area labeled “1”.

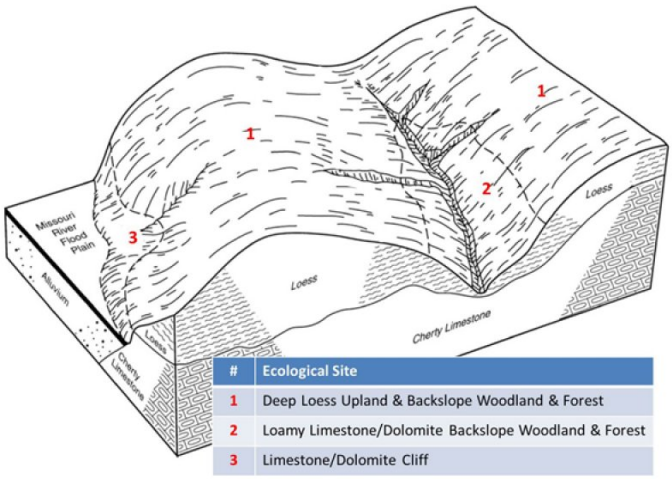


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Hill
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	104–311 m
Slope	15–60%
Water table depth	91–152 cm
Aspect	NW, N, NE, E

Climatic features

The Central Mississippi Valley Wooded Slopes, Western Part has a continental type of climate marked by strong seasonality. In winter, dry-cold air masses, unchallenged by any topographic barriers, periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses, equally unchallenged by topographic barriers, swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes. In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses.

The Central Mississippi Valley Wooded Slopes, Western Part experiences regional differences in climates, but these differences do not have obvious geographic boundaries. Regional climates grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line diagonally crossing the MLRA from northwest to southeast. Both mean annual temperature and precipitation exhibit gradients along this line.

The average annual precipitation in most of this area is 38 to 48 inches. The average annual temperature is 53 to 57 degrees F. Mean January minimum temperature follows the northwest-to-southeast gradient. However, mean July maximum temperature shows hardly any geographic variation in the MLRA. Mean July maximum temperatures have a range of only two or three degrees across the area.

Mean annual precipitation varies along the same gradient as temperature. Seasonal climatic variations are more complex. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer. Snowfall is common in winter.

During years when precipitation is normal, moisture is stored in the soil profile during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and

transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly affects plant and animal life by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. In regions of appreciable relief, for example, air drainage at nighttime may produce temperatures several degrees lower in valley bottoms than on side slopes. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in valley bottoms. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these unvegetated surfaces create characteristic glade and cliff ecological sites. Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier than adjacent north- and-east-facing slopes. Finally, the climate within a canopied forest ecological site is measurably different from the climate of the more open grassland or savanna ecological sites.

Source:
University of Missouri Climate Center - http://climate.missouri.edu/climate.php;

Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, United States Department of Agriculture Handbook 296 - http://soils.usda.gov/survey/geography/mlra/

Table 3. Representative climatic features

Frost-free period (characteristic range)	164-176 days
Freeze-free period (characteristic range)	193-202 days
Precipitation total (characteristic range)	1,067-1,168 mm
Frost-free period (actual range)	163-187 days
Freeze-free period (actual range)	190-204 days
Precipitation total (actual range)	1,041-1,245 mm
Frost-free period (average)	171 days
Freeze-free period (average)	198 days
Precipitation total (average)	1,118 mm

Climate stations used

- (1) WELDON SPRING NWS [USC00238805], Saint Charles, MO
- (2) ALTON MELVIN PRICE L&D [USC00110137], West Alton, IL
- (3) NEW FRANKLIN 1W [USC00236012], Franklin, MO
- (4) JACKSON [USC00234226], Jackson, MO

Influencing water features

The water features of this upland ecological site include evapotranspiration, surface runoff, and drainage. Each water balance component fluctuates to varying extents from year-to-year. Evapotranspiration remains the most constant. Precipitation and drainage are highly variable between years. Seasonal variability differs for each water component. Precipitation generally occurs as single day events. Evapotranspiration is lowest in the winter and peaks in the summer. Water stored as ice and snow decreases drainage and surface runoff rates throughout the winter and increases these fluxes in the spring. The surface runoff pulse is greatly influenced by extreme events. Conversion to cropland or other high intensities land uses tends to increase runoff, but also decreases evapotranspiration. Depending on the situation, this might increase groundwater discharge, and decrease baseflow in receiving streams (Vano 2005).

Soil features

These soils have no major rooting restriction. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is loess. The soils have silt loam surface horizons. Subsoils are silt

loam to silty clay loam. Some soils are slightly affected by seasonal wetness. Soil series associated with this site include Drury, Menfro, Stookey, and Winfield.

The accompanying picture of the Menfro series shows a thin, light-colored surface horizon to about 7 inches overlying the brown silt loam to silty clay loam subsoil. The excellent rooting characteristics of Menfro and other soils allow for productive, diverse reference vegetation communities on this ecological site. Scale is in feet.

Figure 9. Menfro series soil profile

Table 4. Representative soil features

Parent material	(1) Loess
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Soil depth	183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	17.78–20.32 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	4.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to help inform land management decisions. Plant

communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

The reference plant community is a forest dominated by an overstory of northern red oak, white oak, white ash, black walnut and sugar maple. The canopy is tall (80 to 100 feet) and well developed (80 to 100 percent closure) with great structural diversity. In the most mesic landscape positions, more shade tolerant and moisture loving species, such as basswood, Kentucky coffeetree, and bitternut hickory would have been in greater abundance.

While fire-prone prairies, savannas and open woodlands surround this region, Deep Loess Protected Backslope Forests historically occurred in the most protected landscape positions on lower, steep slopes in the deeper valleys furthest from the prairie uplands and would have burned less frequently (estimated 15 to 25 years) and with lower intensity. Periodic fires would have removed some of the shade tolerant understory, but it would have quickly recovered.

Deep Loess Protected Backslope Forests would have also been subjected to occasional disturbances from wind and ice, as well as grazing by native herbivores, such as bison, elk, and white-tailed deer. Wind and ice would have periodically opened the canopy up by knocking over trees or breaking substantial branches off canopy trees. Such canopy disturbances allowed more light to reach the ground and favored reproduction of the dominant oak species. Grazing by native large herbivores would have kept understory conditions more open, also creating conditions more favorable to oak reproduction.

Today, most of these communities have been cleared and converted to pasture, or have undergone repeated timber harvest and domestic grazing. Most existing occurrences have a younger (50 to 80 years) canopy layer whose composition has been altered by timber harvesting practices. A few reference states still can be found, primary on public lands. An increase in hickories over historic conditions is common. In addition, in the absence of fire, the canopy, sub-canopy and woody understory layers are better developed. The absence of periodic fire has allowed more shade-tolerant tree species, such as sugar maple, white ash, or hickories to increase in abundance. Current domestic grazing has diminished the diversity and amount of cover of forest ground flora species, and has introduced weedy species such as gooseberry, corlaberry, poison ivy and Virginia creeper which has created a more open understory and increased soil compaction.

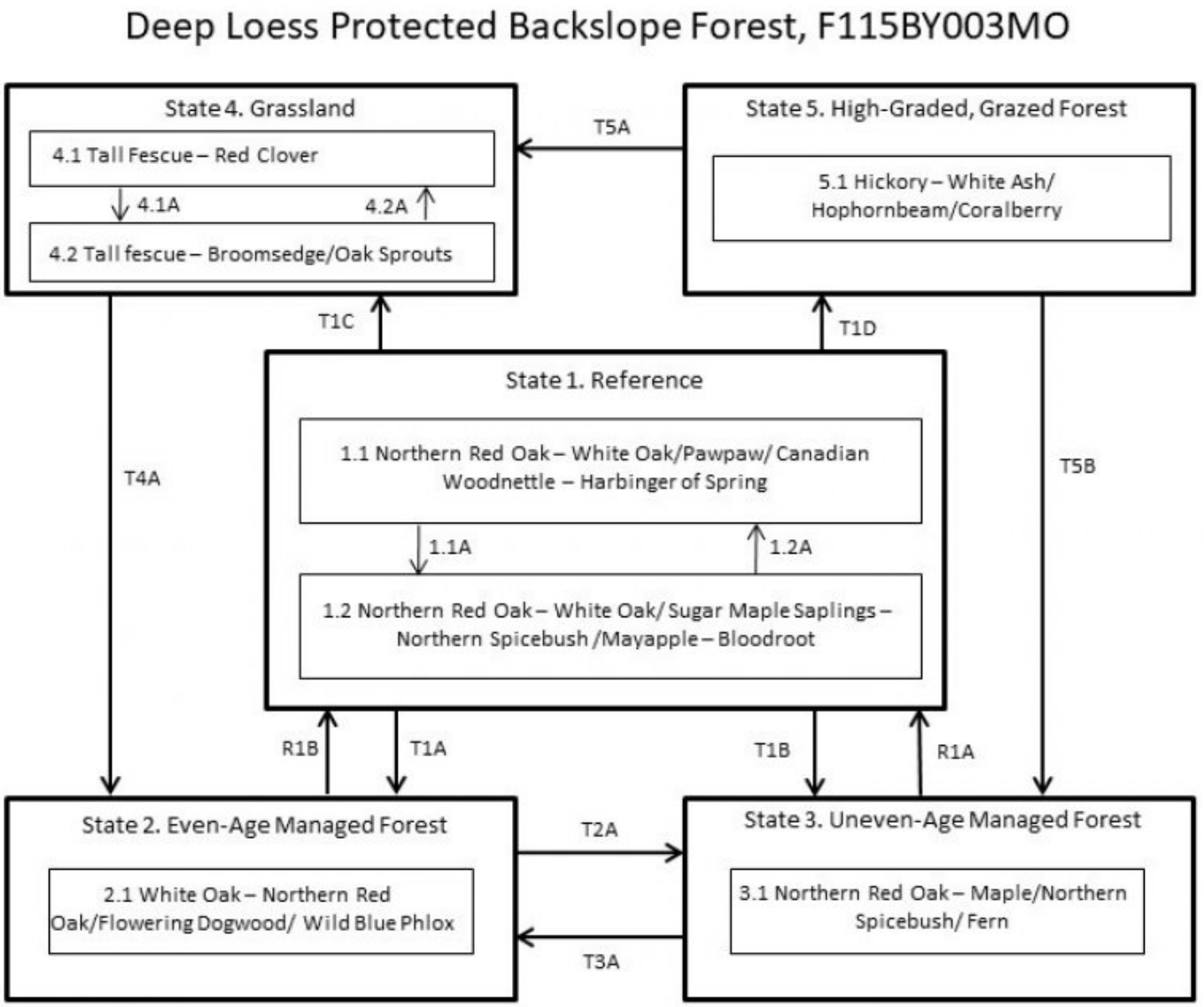
Deep Loess Protected Backslope Forests are the most productive upland timber sites in the region. Carefully planned single tree selection or the creation of small group openings can help regenerate more desirable oak species and increase vigor on the residual trees. Clear-cutting does occur and results in dense, even-aged stands of primarily oak. This may be most beneficial for existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands, the ground flora diversity can be shaded out and productivity of the stand may suffer.

Oak regeneration is typically problematic. Sugar maple, red elm, hophornbeam, hickories, grapes, pawpaw and northern spicebush are often dominant competitors in the understory. Maintenance of the oak component will require disturbances that will impair the cool, moist, shaded conditions, so trade-offs will have to be made carefully. Prescribed fire can play a beneficial but very limited role in the management of this ecological site.

The higher productivity of these sites makes it more challenging than on other forest sites in the region. Protected aspect forests did evolve with some fire, but their composition often reflects more closed, forested conditions, with fewer woodland ground flora species that can respond to fire. Consequently, while having protected aspects in a burn unit is acceptable, targeting them solely for woodland restoration is not advisable.

A State and Transition Diagram follows. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases

State and transition model



Code	Activity/Event/Process
T1A	Harvesting; even-aged management
T1B	Harvesting; uneven-age management
T1C, T5A	Clearing; pasture planting
T1D	High-grade harvesting; uncontrolled grazing
T2A	Uneven-age management
T3A	Even-age management
T4A	Tree planting; long-term succession; no grazing
T5B	Uneven-age management; tree planting; no grazing

Code	Activity/Event/Process
1.1A	No disturbance (20+ yrs)
1.2A	Disturbance (fire, wind, ice) < 10 yrs
4.1A	Over grazing; no fertilization
4.2A	Brush management; grassland seeding; grassland management

Code	Activity/Event/Process
R1A, R1B	Forest stand improvement; extended rotations

Figure 10. State and transition diagram for this ecological site

State 1

Reference

The Reference State was dominated by white oak and northern red oak. Maximum tree age was likely 150 to 300 years. Periodic disturbances from fire, wind or ice maintained the dominance of white oak and red oak by opening up the canopy and allowing more light oak reproduction. Long disturbance-free periods allowed an increase in more shade tolerant species such as basswood and sugar maple. Two community phases are recognized in this state, with shifts between phases based on disturbance frequency. This Reference State is rare today. Some sites have been converted to grassland (State 4). Others have been subject to repeated, high-graded timber harvest coupled with domestic livestock grazing (State 5). Fire suppression has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Many Reference sites have been managed for timber harvest, resulting in either even-age (State 2) or uneven-age (State 3) forests.

Dominant plant species

- white oak (*Quercus alba*), tree
- northern red oak (*Quercus rubra*), tree
- flowering dogwood (*Cornus florida*), tree
- sugar maple (*Acer saccharum*), tree
- American basswood (*Tilia americana*), tree
- white ash (*Fraxinus americana*), tree
- pawpaw (*Asimina triloba*), tree
- northern spicebush (*Lindera benzoin*), shrub
- wild blue phlox (*Phlox divaricata*), other herbaceous
- mayapple (*Podophyllum peltatum*), other herbaceous
- Virginia snakeroot (*Aristolochia serpentaria*), other herbaceous
- Christmas fern (*Polystichum acrostichoides*), other herbaceous
- Canadian woodnettle (*Laportea canadensis*), other herbaceous
- harbinger of spring (*Erigenia bulbosa*), other herbaceous

Community 1.1
Northern Red Oak – White Oak/Pawpaw/ Canadian Woodnettle – Harbinger of Spring

Figure 11. MDC Hart Creek Conservation Area, Boone County, MO

This community is the most productive upland forest in the MLRA. This forest community has a multi-tiered structure, and a canopy that is 75 to 100 feet tall with 80 to 100 percent closure. The sub-canopy and understory are well developed. An abundance of shade tolerant forest generalists, such as May apple, Christmas fern, tick trefoil and white snakeroot, cover the ground. In the absence of disturbance, more shade tolerant species increase such as sugar maple, basswood, white ash and others increase in importance and add structural diversity to the system. In addition, more shade-loving forest shrub (e.g., spicebush) and herbaceous (e.g., bloodroot) species also increase.

Forest overstory. The Overstory Species list is based on field surveys and commonly occurring species listed in Nelson (2010).

Forest understory. The Understory Species list is based on field surveys and commonly occurring species listed in

Nelson (2010).

Community 1.2
Northern Red Oak – White Oak / Sugar Maple Saplings – Northern Spicebush/ Mayapple – Bloodroot

The overstory is a mixture of more shade tolerant species such as northern red oak, sugar maple, basswood, white ash and others. This forest community has a multi-tiered structure, and a canopy that is 75 to 100 feet tall with 90 to 100 percent closure. An abundance of shade tolerant forest generalists, such as May apple, Christmas fern, tick trefoil and white snakeroot, cover the ground. In addition, more shade-loving forest shrub (e.g., spicebush) and herbaceous (e.g., bloodroot) species are common.

Pathway P1.1A
Community 1.1 to 1.2

This pathway is the result of disturbance-free interval 10 to 20 years.

Pathway P1.2A
Community 1.2 to 1.1

This pathway is the result of disturbance activities on a 15-to-25-year cycle being reestablished.

State 2
Even-Age Managed Forest

These forests tend to be rather dense, with an under developed understory and ground flora. Thinning can increase overall tree vigor and improve understory diversity. Continual timber management, depending on the practices used, will either maintain this state, or convert the site to uneven-age (State 3) forests.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- white oak (*Quercus alba*), tree
- flowering dogwood (*Cornus florida*), tree
- sugar maple (*Acer saccharum*), tree
- wild blue phlox (*Phlox divaricata*), other herbaceous

Community 2.1
White Oak – Red Oak/Flowering Dogwood/ Wild Blue Phlox

This is an even-aged forest management phase. Logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in red oak. Large group, shelterwood or clearcut harvests create a more uniform age class structure throughout the canopy layer while also opening up the understory and allowing more sunlight to reach the forest floor.

State 3
Uneven-Age Managed Forest

Uneven-Age Managed forests resemble the Reference State. The biggest difference is tree age, most being only 50 to 90 years old. Composition is also likely altered from the reference state depending on tree selection during harvest. In addition, without a regular 15 to 20 year harvest re-entry into these stands, they will slowly increase in more shade tolerant species such as sugar maple and white oak will become less dominant.

Dominant plant species

- northern red oak (*Quercus rubra*), tree
- sugar maple (*Acer saccharum*), tree
- northern spicebush (*Lindera benzoin*), shrub

- Christmas fern (*Polystichum acrostichoides*), other herbaceous
- broad beechfern (*Phegopteris hexagonoptera*), other herbaceous

Community 3.1
Northern Red Oak – Maple/Northern Spicebush/ Fern

This is an uneven-aged forest management phase. Selective logging activities are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in northern red oak and sugar maple. Densities numbers, especially more shade tolerant species, are increasing at the lower size-class levels.

State 4
Grassland

Conversion of forests to planted, non-native pasture species such as tall fescue has been common in this MLRA. Steep slopes, abundant surface fragments, low organic matter contents and soil acidity make non-native pastures challenging to maintain in a healthy, productive state on this ecological site. If grazing and active pasture management is discontinued, the site will eventually transition to State 2 (Even-Age).

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- red clover (*Trifolium pratense*), other herbaceous

Community 4.1
Tall Fescue – Red Clover

This phase is well managed grassland, composed of non-native cool season grasses and legumes. Grazing and haying is occurring.

Community 4.2
Tall fescue – Broomsedge/Oak Sprouts

Over time without disturbance or management oak sprouts will begin to establish.

Pathway P4.1A
Community 4.1 to 4.2

This pathway is the result of over grazing and lack of proper grassland management.

Pathway P4.2A
Community 4.2 to 4.1

This pathway is the result of brush management, grassland reseeding and proper grassland management.

State 5
High-Graded, Grazed Forest

Forested sites subjected to repeated, high-graded timber harvests and uncontrolled domestic grazing transition to this State. This state exhibits an over-abundance of hickory and other less desirable tree species, and weedy understory species such as buckbrush, gooseberry, poison ivy and Virginia creeper. The vegetation offers little nutritional value for cattle, and excessive stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff. Exclusion of livestock from sites in this state coupled with uneven-age management techniques will cause a transition to State 3 (Uneven-Age).

Dominant plant species

- bitternut hickory (*Carya cordiformis*), tree
- white ash (*Fraxinus americana*), tree

- Virginia creeper (*Parthenocissus quinquefolia*), tree
- currant (*Ribes*), shrub
- coralberry (*Symphoricarpos orbiculatus*), shrub
- eastern poison ivy (*Toxicodendron radicans*), other herbaceous
- Virginia creeper (*Parthenocissus quinquefolia*), other herbaceous

Community 5.1
Hickory – White Ash/Hophornbeam/Coralberry

Due to high-grade logging and uncontrolled grazing, this community phase exhibits an over-abundance of hickory and other less economically desirable tree species and weedy understory species such as buckbrush, gooseberry, poison ivy and multi-flora rose. The understory vegetation offers little nutritional value for cattle, and excessive livestock stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff.

Transition T1A
State 1 to 2

This transition is the result of harvesting and even-aged management.

Transition T1B
State 1 to 3

This transition is the result of harvesting and uneven-age management.

Transition T1C
State 1 to 4

This transition is the result of clearing and conversion to non-native cool season grassland.

Transition T1D
State 1 to 5

This transition is the result of high-grade logging and uncontrolled domestic livestock grazing.

Restoration pathway R1B
State 2 to 1

This restoration pathway is the result of forest stand improvement and extended rotations.

Transition T2A
State 2 to 3

This transition is the result of uneven-age management.

Restoration pathway R1A
State 3 to 1

This restoration pathway is the result of forest stand improvement and extended rotations.

Transition T3A
State 3 to 2

This transition is the result of even-age management.

Transition T4A

State 4 to 2

This transition is the result of tree planting, long-term succession and no grazing.

Transition T5B
State 5 to 3

This transition is the result of uneven-age management, tree planting and no grazing.

Transition T5A
State 5 to 4

This transition is the result of clearing and conversion to non-native cool season grassland.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white oak	QUAL	*Quercus alba*	Native	–	30–50	–	–
northern red oak	QURU	*Quercus rubra*	Native	–	30–50	–	–
sugar maple	ACSA3	*Acer saccharum*	Native	–	5–20	–	–
slippery elm	ULRU	*Ulmus rubra*	Native	–	10–20	–	–
white ash	FRAM2	*Fraxinus americana*	Native	–	10–20	–	–
black walnut	JUNI	*Juglans nigra*	Native	–	5–10	–	–
bitternut hickory	CACO15	*Carya cordiformis*	Native	–	5–10	–	–
American basswood	TIAM	*Tilia americana*	Native	–	5–10	–	–
tuliptree	LITU	*Liriodendron tulipifera*	Native	–	1–5	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
eastern woodland sedge	CABL	*Carex blanda*	Native	–	0–5
Forb/Herb					
wild blue phlox	PHDI5	*Phlox divaricata*	Native	–	10–30
mayapple	POPE	*Podophyllum peltatum*	Native	–	10–30
harbinger of spring	ERBU	*Erigenia bulbosa*	Native	–	10–30
Virginia springbeauty	CLVI3	*Claytonia virginica*	Native	–	10–30
dutchman's breeches	DICU	*Dicentra cucullaria*	Native	–	10–20
white fawnlily	ERAL9	*Erythronium albidum*	Native	–	10–20
Virginia snakeroot	ARSE3	*Aristolochia serpentaria*	Native	–	10–20
white baneberry	ACPA	*Actaea pachypoda*	Native	–	5–20
largeflower bellwort	UVGR	*Uvularia grandiflora*	Native	–	10–20
Canadian woodnettle	LACA3	*Laportea canadensis*	Native	–	10–20
toadshade	TRSE2	*Trillium sessile*	Native	–	10–20
smooth Solomon's seal	POBI2	*Polygonatum biflorum*	Native	–	10–20
goldenseal	HYCA	*Hydrastis canadensis*	Native	–	10–20
Jack in the pulpit	ARTR	*Arisaema triphyllum*	Native	–	10–20
green dragon	ARDR3	*Arisaema dracontium*	Native	–	5–10
Fern/fern ally					
Christmas fern	POAC4	*Polystichum acrostichoides*	Native	–	5–20
broad beechfern	PHHE11	*Phegopteris hexagonoptera*	Native	–	5–20
Shrub/Subshrub					
northern spicebush	LIBE3	*Lindera benzoin*	Native	–	5–10
Tree					
pawpaw	ASTR	*Asimina triloba*	Native	–	5–20
American bladdernut	STTR	*Staphylea trifolia*	Native	–	5–10
flowering dogwood	COFL2	*Cornus florida*	Native	–	5–10
hophornbeam	OSVI	*Ostrya virginiana*	Native	–	5–10
Vine/Liana					
Virginia creeper	PAQU2	*Parthenocissus quinquefolia*	Native	–	10–20

Animal community

Wildlife Species (MDC 2006):

Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type.

Birds associated with this ecological site include Worm-eating warbler, Whip-poor-will, Great Crested Flycatcher, Ovenbird, Pileated Woodpecker, Wood Thrush, Red-eyed Vireo, Northern Parula, Louisiana Waterthrush (near streams), and Broad-winged Hawk.

Reptile and amphibian species associated with mature forests include: ringed salamander, spotted salamander, marbled salamander, central newt, long-tailed salamander, dark-sided salamander, southern red-backed salamander, three-toed box turtle, western worm snake, western earth snake, and American toad.

Other information

Forestry (NRCS 2002, 2014)
Management: Field collected site index values average 77 for all species and 87 for northern red oak. Timber management opportunities are excellent. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection or small group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. Uneven-aged management will slowly cause an increase in more shade tolerant species such as sugar maple. Using prescribed fire as a management tool could have a negative impact on timber quality, may not be fitting, or should be used with caution on a particular site if timber management is the primary objective.

Limitations: No major equipment restrictions or limitations exist. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Deep Loess Protected Backslope Forest – Potential Reference Sites

Plot HACRCA_JK02 – Menfro soil
Located in Hart Creek CA, Boone County, MO
Latitude: 38.718586
Longitude: -92.32617966

Plot HACRCA_JK03 – Menfro soil
Located in Hart Creek CA, Boone County, MO
Latitude: 38.718249
Longitude: -92.32712605

Plot HACRCA_JK04 – Menfro soil
Located in Hart Creek CA, Boone County, MO
Latitude: 38.712871
Longitude: -92.3291663

Plot HACRCA_KS06 – Menfro soil
Located in Hart Creek CA, Boone County, MO
Latitude: 38.711684
Longitude: -92.327958

Plot ROCACA_JK02 – Menfro soil
Located in Rocheport Cave CA, Boone County, MO
Latitude: 38.94349
Longitude: -92.51829435

Plot SCWOUM_JK04 – Menfro soil
Located in Schnabel Woods, UMC, Boone County, MO
Latitude: 38.8743
Longitude: -92.42840552

Plot TRTESP_KS03 – Menfro soil – no veg cover
Located in Trail of Tears SP, Cape Girardeau County, MO
Latitude: 37.468375
Longitude: -89.487986

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Contributors

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Approval

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/13/2025
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
